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4	15	(hierarch$9 near server$5) and (ip near address$3 near3 allocat$5)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/11/08 15:24
5	0	(hierarch$9 near server$5) with (manag$5 near9 (ip (ip near address$5)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/11/08 15:25
6	34	(hierarch$9 near server$5) and (manag$5 near9 (ip (ip near address$5)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/11/08 15:27
7	2	dynamic near network near configurat$9 near protocol$3	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/11/08 16:34
10	0	dynamic adj network adj configurat$9 adj protocol$3	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/11/08 16:34

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Improvement of Dynamic Network Configuration Protocol and Its Evaluation

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※4 Faculty of Environmental Information, Keio University

This paper improves **Dynamic Network Configuration Protocol** (DNCP) thatmanages IP addresses for networks.First, scalability is improved to enable DNCP operation in the wide area network.Networks are categorized into ``Core'' and ``Leaf'' parts,and new DNCP works differently in each part.Specially, ``Hierarchical Grouping'',which forms groups based on the logical relation between servers,is introduced and improves stability of DNCP.Then, the policing mechanism that keeps the rate of used IP addresseswithin a range is introduced for efficient IP address management.Next, the authentication mechanism is added to exclude requests from invalid hosts.This paper implements improved DNCP and evaluate it.Several experiments to check functions of DNCP were done in a small network,and other experiments to measure performance were

done in a large network with simulation.Results show that processing speed were enough while achieving efficient IP address management.Last part of this paper considered application of DNCP to the Internet.

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IP addresses

The designers of the Internet envisioned it as an **end-to-end** network in which each host had a unique address, its **Internet Protocol** (**IP**) **address**. This note talks about end-to-end addressing. We will see a variation, **network address translation** (**NAT**), in another note.

An **IP packet** consists of the data being transmitted and a fixed length header block:

Header (20 bytes)	Data (variable length)

The header contains 12 fields and is 20 bytes long. Two of those fields are the source and destination IP addresses. Since the address fields are 32 bits each the theoretical **address space** is as follows:

Number system	Smallest address	Largest ad
Binary	00000000.00000000.00000000.00000000	11111111.11111111.11
Decimal	0.0.0.0	255.255.255.255
Hexadecimal	00.00.00.00	FF.FF.FF.FF

In decimal, that would a range of 0 to 4,294,967,295, giving 4,294,967,296 unique addresses.

As you see, IP addresses are long numbers in binary, so we typically write them in decimal or hexadecimal with dots separating the four bytes.

For example, sws.csudh.edu has the IP address 155.135.1.163.

You can see the IP address of the computer you are currently using by opening a DOS command window and giving the ipconfig command.

An IP address is broken down into two parts, the network identifier and the host identifier. Routers use the network identifier to deliver a packet to its destination network and the routers and switches within that network deliver it to the destination host.

For example, CSUDH has been assigned a network address of 155.135, so the IP addresses on our campus run from 155.135.0.0 to 155.135.255.255. Internet routers use the 155.135 portion of the address to get a packet to our campus, and our router and switches take over from there.

That says the off-campus routers pay attention to the 16 high-order bits, ignoring the 16 low-order bits and on campus we can do the opposite. Rather than saying we "ignore" certain bits, programmers say they are **masked** out.

Some IP addresses are reserved. One special address is 127.0.0.1 which is reserved for **local loop back**. If an application sends a packet to this address, it is fed back into the sending machine as if it had come from the outside. This is very handy when you are running a client and server on your own machine, for example, a local Web server for development testing.

Several blocks of the IP address space are also reserved as **non-routable addresses** which are to be used solely within a LAN. We will discsuss these when we talk about NAT.

Keio University, Graduate School of Media and Governance
MAUI Project
Ph.D. Dissertation

[English | Japanese]
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YEAR	**1999**
NAME	**TOMINAGA, Akihiro** same person/inventor as the present invention
TITLE	**A Study on Mechanism for Global and Dynamic Management of Network Addresses**
ABSTRACT	This dissertation proposes and describes the implementation of the "Automatic Address Assignment Mechanism: AAAM," a mechanism that automatically manages IP addresses in middle to large scale networks. Since IP addresses are managed in a hierarchy in AAAM, it is highly scalable, supports proper authorization and policing for management and operation, and allows for autonomous distributed processing. The subject of full automatic management of network addresses in a large scale network has never been addressed before in previous papers, and this dissertation establishes a foundation in this area. The first part of this dissertation presents a survey of existing schemes that manage IP addresses manually, and shows that IP addresses are currently managed in a hierarchy consisting of hosts, subnets, organizations, countries, and the entire world. The survey also reveals that dynamic address allocation and automatic address renumbering for subnets or organizations has not been achieved. These investigations show that individual mechanisms for host, subnet, and organization are required. First, this dissertation presents the Dynamic Host Configuration Protocol (DHCP), which was standardized by the IETF, as the mechanism for IP address allocation and configuration of individual hosts. An implementation of DHCP is described and evaluated. The implementation, which was freely distributed, passed an interoperability test, an operation test in large network, and an endurance test. Next, the **Dynamic Network Configuration Protocol** (DNCP) is proposed in this dissertation. DNCP supports IP address allocation and configuration of subnets. DNCP adopts the "Hierarchical Server Model" that determines a hierarchy from the network topology and manages IP addresses based on this hierarchy. Thirdly, AAAM that supports IP address allocation of organizations is proposed. AAAM uses both DNCP and DNCP+ (the improved version of DNCP) to enable IP address management in organizations and automatic address configuration in subnets. DNCP+ adopts "Hierarchical Grouping" that defines a hierarchy independent from the network topology for high scalability and stability.

	AAAM implements renumbering and retrieving of IP addresses. AAAM also supports authorization and policing mechanisms that are necessary for system administration. Implementations were tested in a real small network and a network emulator. Another test also proved that the utilization rate of IP addresses of AAAM is higher than that of manual allocation. It was also shown that with AAAM address were managed properly despite changes in the networks due to addition or disconnection of networks. Through evaluation tests on a network emulator, it was shown that AAAM could perform well enough for practical use. From these results it can be concluded that it is useful to manage IP addresses in a hierarchy. Finally, the dissertation concludes with discussions on issues such as the validity of the management algorithm, performance and scalability of AAAM, and possibility of global IP address management.
CONTACT	To obtain the whole paper, please contact; Akihiro Tominaga tomy@wide.ad.jp

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